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ABSTRACT

Intended as a starting point for junior and senior high school teachers, this guide contains five lessons that give an overview of the nuclear age and provide the most basic information that students must learn in order to understand the threat of nuclear war. Topics of the lessons include the history of weapons development, how nuclear weapons are different, the United States/USSR arms race, the current state of affairs regarding nuclear weapons, the effects of nuclear war, and what can be done to prevent nuclear war. Provided for each lesson are an outline of the main ideas, relevant quotations that complement the outline, learning aids that explain important facts within the lesson (e.g., maps, charts, graphs, lists of organizations), and discussion questions. Students are expected to read and study the outline and quotations, analyze the maps, charts, and graphs, and participate in classroom discussions. Provided at the end of the guide are some additional learning tools and resources, including a glossary of nuclear war terms, suggested learning exercises, a bibliography, and audiovisual suggestions which can supplement the various lessons. (RM)

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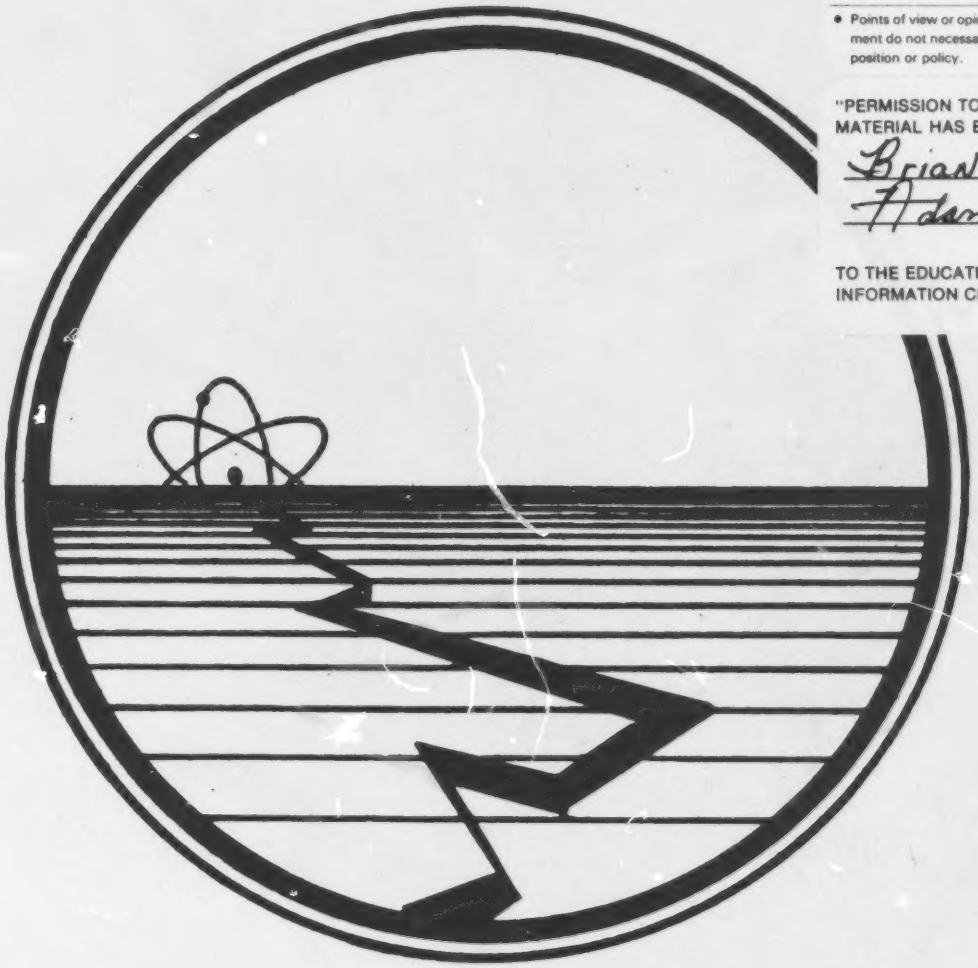

The Nuclear Age

A Curriculum Guide for Secondary Schools

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THE NUCLEAR AGE

A GROUND ZERO CURRICULUM GUIDE

Ground Zero has prepared this secondary school curriculum guide in response to the almost overwhelming interest that was expressed by teachers as a result of Ground Zero Week, April 18-25, 1982. During that week, thousands of teachers from around the country conducted educational programs in their classrooms about the threat of nuclear war. We surveyed many of the teachers after the week and found that almost all had the same experience: they found that students were hungry for information about nuclear war issues and yet many expressed concern about the lack of basic educational materials that are appropriate for the classroom. This basic curriculum guide is an effort to meet this clear need.

This curriculum guide is intended as a starting point for junior and senior high school teachers. It contains five lessons that give an overview of The Nuclear Age and provide the most basic information that students must learn in order to understand the threat of nuclear war. Each lesson contains an outline, relevant quotations that complement the outline, learning aids that explain important facts within the lesson, and discussion questions. In addition to the five lessons, learning tools and resources that can assist teachers to go beyond the basic content of these lessons are included at the end. These resources include: a glossary of nuclear war terms, suggested learning exercises, bibliography, and audio-visual suggestions which can supplement the various lessons.

We at Ground Zero hope that these curriculum suggestions will assist you in the vitally important task of educating today's young people about the new realities which exist in The Nuclear Age. We exist as an organization because we believe that widespread education about the threat we face from nuclear weapons is the most effective means for preventing a nuclear holocaust. Teachers have a direct and indispensible role in bringing about this type of education and our goal is to assist you in doing that job effectively.

Ground Zero intends to supplement this basic curriculum guide with more in-depth lessons about The Nuclear Age that will be prepared from time to time. The first of these should be available for the 1983-84 school year, and we will keep you posted about these and other future publications that may be of interest to you.

Roger Molander
Executive Director
GROUND ZERO
December, 1982

ABOUT GROUND ZERO

Ground Zero is a nationwide educational organization that exists for the purpose of educating the American people about the threat of nuclear war and involving them in the effort to prevent it. Ground Zero believes that Albert Einstein analyzed our age correctly when he said, "The splitting of the atom has changed everything except our way of thinking. Thus, we drift towards unparalleled catastrophe." Ground Zero believes that only through education can we find the "new ways of thinking" that are necessary to prevent nuclear war.

Ground Zero was founded in early 1981 by Dr. Roger Molander, who served for seven years in the White House as a strategic nuclear weapons expert on the National Security Council. Dr. Molander began Ground Zero because his experience in the White House convinced him that our government cannot adequately meet the threat posed by nuclear war unless citizens are better educated on the issue and more fully able to participate in national security decision-making.

ACKNOWLEDGEMENTS

This curriculum guide was developed and compiled by a team of Ground Zero volunteers and staff members under the direction of Theo Brown, Ground Zero's Deputy Director. More than a dozen volunteers gave time to this project over a several month period and five of them, Star Northam, Jay Keller, Claudia Ringel, Larry Fuell, and Ross Taylor, formed the core committee that developed this curriculum format. Star Northam deserves special recognition for coordinating this group and for many days of volunteer effort at the Ground Zero office where the ideas of the committee were turned into reality. In addition, Ground Zero national staff members Pat Campbell and Robbie Nichols made an invaluable contribution by working with Theo Brown to edit the materials and turn them into a finished product.

LESSON ONE Nuclear Weapons: The Quantum Leap

A. The History of Weapons Development

1) In the Beginning
   a. The first weapons were stones, clubs and spears, all of which were powered directly by the human arm.
   b. The "extended arm," delivery systems such as slings (for stones), crossbows (for arrows) and catapults, extended the range of the most primitive weapons.

2) Modern Weapons
   a. The discovery of gun powder led to the development of longer range and more accurate weapons, which are powered by the force of an explosion.
   b. These weapons include guns, cannon, machine guns, artillery, and bombs of all shapes and sizes.

3) Nuclear Weapons: A Whole New Ballgame
   a. In destructive power, the first atomic bomb was 5,000 times more powerful than a conventional bomb of the same weight. The first hydrogen bomb was 60 times more powerful than that.
   b. In addition to the immediate, local effects of a nuclear weapon detonation, the effect of radioactivity on human beings and their environment is far-reaching in both range and duration.
   c. Nuclear weapons have completely altered the nature of warfare because of their enormous, unprecedented destructive capabilities.

4) From Catapults to Cruise Missiles: Advanced Delivery Systems
   a. Modern delivery systems have given nuclear weapons the ability to strike suddenly from great distances.
      1. Airplanes make it possible to transport bombs to an opponent's homeland; to strike behind his front-line forces and affect his war-fighting ability (so-called "strategic warfare").
      2. Missiles can be launched from great distances and deliver nuclear weapons quickly and accurately. It takes only 30 minutes for missiles to travel from the U.S. to the Soviet Union, and neither country has any defense against them.
   b. Today's advanced delivery systems greatly reduce the amount of time during which an initial decision to attack can be reversed.

B. How Nuclear Weapons Are Different

1) The Explosion Itself
   a. A conventional explosion results from an interaction between atoms.
   b. A nuclear explosion results from an interaction within atoms, either from the splitting (fission) or bonding (fusion) of the protons and neutrons in the atom.
      1. The forces between protons and neutrons within the atom are tremendously greater than the forces between atoms. When scientists first "split" the atom, they unleased the essential "energy of the cosmos," the energy latent in mass.
      2. A nuclear explosion is caused by the chain reaction of an atom splitting and releasing neutrons which can themselves split more neutrons. The reaction occurs at tremendous speeds -- as quickly as a millionth of a second.

2) Blast, Heat and Radiation
   a. Blast causes immediate destruction through the sudden release of energy in both conventional and nuclear explosions, but,
      1. Nuclear explosions may be many thousands to millions of times more powerful than even the largest conventional explosion.
      2. When the atom is split and causes a chain reaction, all materials are converted into hot compressed gases which expand so rapidly as to produce a blast wave moving outward faster than the speed of sound.
   b. Heat, or thermal radiation, occurs in several forms:
      1. The fireball -- In the center of a nuclear explosion, temperatures reach millions of degrees, which is as hot as the sun.
      2. Speed -- The heat travels at the speed of light, 186,000 miles per second, in the same way that lightning precedes thunder, a burning flash of light precedes the blast.
      3. Firestorms - Fires that spread due to high winds from the blast can incinerate everything in their path as well as exhaust the oxygen supply in a given area.
   c. Radiation (in the form of gamma rays, neutrons, and alpha and beta particles) accompanies every nuclear explosion:
      1. Initial radiation is that emitted in the form of neutrons and gamma rays during the actual explosion. The area surrounding detonation ("ground zero") thus becomes highly radioactive.
      2. Residual radiation, or fallout, consists of the radioactive particles (thousands of tons of them in larger detonations) which are swept up into the atmosphere and eventually fall to earth. The smallest particles ascend into the upper atmosphere, travel great distances and fall to earth months or years later. Some fallout from nuclear testing done by the U.S. and the Soviet Union in the 1950's is still being found.
      3. The combined, instantaneous effects of blast and thermal radiation plus the long-term contamination from nuclear radiation would disrupt the environment and every aspect of human life to such an extent that target areas would be uninhabitable for many years.

C. The First Atomic Bomb and the Advent of the Nuclear Age

1) The Manhattan Project
   a. A secret project to create the atomic bomb; begun during World War II out of fear that Nazi Germany might beat us to it.
   b. Directed by Robert J. Oppenheimer at Los Alamos, New Mexico.
   c. Trinity - the first successful atomic bomb test; took place at Almagordo, New Mexico, in July 1945.
2) Weighing the Choices on Dropping the Bomb
   a. Pro: the probability of ending war with Japan (Germany had already surrendered) and saving hundreds of thousands of U.S. lives.
   b. Con: fear of an escalating arms race; fear of misuse and unrestrained proliferation; the recognition that Japan was already defeated and eventual surrender was certain.
3) The Final Decision
   a. President Harry Truman, entering office after Roosevelt's death, issues an ultimatum of unconditional surrender to Japan but is refused. The secret of the A-bomb's existence is maintained.
   b. On August 6, 1945, an atomic bomb (with uranium fuel) is carried in a B-29 bomber, the "Enola Gay," and dropped on the Japanese

city of Hiroshima. The explosive power is equal to 12,500 tons of TNT and an estimated 75,000 people are killed instantly.

c. Three days later, on August 9, 1945, a second atomic bomb (with plutonium fuel) is dropped on the city of Nagasaki, killing an estimated 100,000 people (these figures are not comprehensive, because people from both cities are still dying of radiation-related illnesses).

d. Japan surrenders on August 15, 1945. World War II ends, and the world has entered the Nuclear Age.

LESSON ONE: Relevant Quotes

The center of a nuclear warhead is a sphere of plutonium. This is where a nuclear explosion -- the sudden release of nuclear energy -- starts. This process is set off by a network of conventional (chemical) fuses that are timed to burn in from the outside to the center. As they burn inwards, the plutonium in the middle gets compressed. The plutonium atoms get squashed so close together that the nuclei of different atoms begin to affect each other differently from before. Some neutrons are free to move away from one nucleus and get close to another nucleus. This can make the second nucleus split, and as soon as a few nuclei split a chain reaction builds up in millions of other atoms.

Energy released by the fission of the plutonium core is absorbed by the ring of deuterium and tritium surrounding it (see diagram 4). Millions of deuterium and tritium atoms fuse together and the neutrons that are released from the fusion reactions travel on into the uranium layer. This starts the fission of the uranium nuclei and a chain reaction builds up there too.

All this takes place within about a millionth of a second. So much energy is released that the temperature of the materials of the warhead reaches 130 million degrees. This is a phenomenal temperature; it is as hot as the sun. The pressure inside the warhead is also enormous: about 100 million times greater than normal air pressure.

Energy is directly connected with both temperature and pressure. In fact, what we call "heat" is simply one form of energy. A flame, or the electric rings on an oven, both give out waves of heat energy. Things nearby absorb enough of the energy to get noticeably hotter themselves and in a nuclear explosion, everything in the warhead gets extremely hot. Pressure, on the other hand, measures the force per unit area with which one thing presses against another. The higher the temperature, the faster atoms move and the higher the pressure they exert on whatever they press against. In the case of a nuclear explosion, the super-hot atoms in the warhead literally explode outwards in all directions, pushing on the atoms of the air or the ground with a huge force.

-- Curriculum Guide, Educators for Social Responsibility

TNT is barely twice as strong as black powder was six centuries ago. World War II developed explosives up to 60% more powerful than TNT. The atomic bomb is more than 12,000 times as strong as the best improvement on TNT.

-- Time, August 20, 1945.

The H-bomb is far more than just another weapon with greater destructive power. Nor does its tremendous strategic value stem from its destructive power alone. Of equal importance is the fact that there are now in existence delivery systems which can take the bomb at ever increasing speeds to any target on earth. It is this unparalleled combination of packaged firepower and delivery systems that has revolutionized warfare . . .

Despite the worldwide devastation of hundreds of major population and industrial centers and despite tens of millions of military and civilian casualties, most of the nations involved in World War II were able to stage a remarkable recovery. . . Such a rapid and effective recovery would be impossible after an all-out nuclear war. Casualties would be so vast, destruction so prohibitive that the recovery effort would be impeded seriously and take many more years than it did after World War II . . .

No hydrogen bomb has ever been dropped in wartime, but this much we have learned from testing it -- the bomb is so unbelieveably powerful that, in comparison, the atom bombs loosed on Hiroshima and Nagasaki seem like mere firecrackers. All the bombs dropped by the Allies during World War II, both in the European and Pacific Theatres, totalled about 3,350,000 tons. In modern nuclear parlance, this figure is expressed as 3.35 megatons, which is less than the yield of one medium-sized hydrogen bomb or missile warhead.

Today, preparations for large-scale aggression no longer entail suspicious and extensive movements of ground troops or warships. The initial and, possibly, decisive phase of a nuclear war can be initiated from any convenient and desired location -- missile-launching sites and air bases, thousands of miles from their intended targets or missile-equipped submarines and aircraft carriers far out at sea. Indeed, modern weapons have ushered in the era of "long-distance wars," wars that can be carried on from the home bases of countries half a world apart.

-- General Thomas S. Power, Design for Survival

War has become not just tragic but preposterous. With modern weapons there can be no victory for anyone.

-- President Dwight David Eisenhower

LESSON ONE: Learning Aids

Figure 1

The atom is the basic component in matter.

An atom consists of a nucleus surrounded by orbiting electrons. The negatively charged electrons are held in orbit by the positively charged protons and neutrons which have no electric charge.

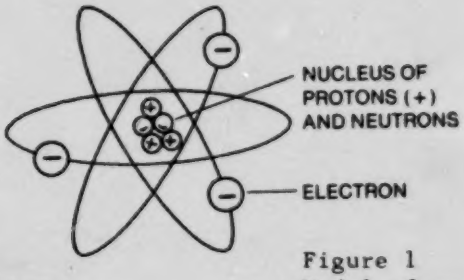


Figure 1
Model of an Atom

Figure 2

In a fission reaction, uranium atoms are bombarded with neutrons, causing the uranium nuclei to split. When a uranium nucleus is split, it releases two or three neutrons at extraordinary speeds, plus additional energy in the form of gamma rays. The energy released in such an explosion results from the conversion of some of the mass of the uranium into energy according to Einstein's famous equation $e=mc^2$.

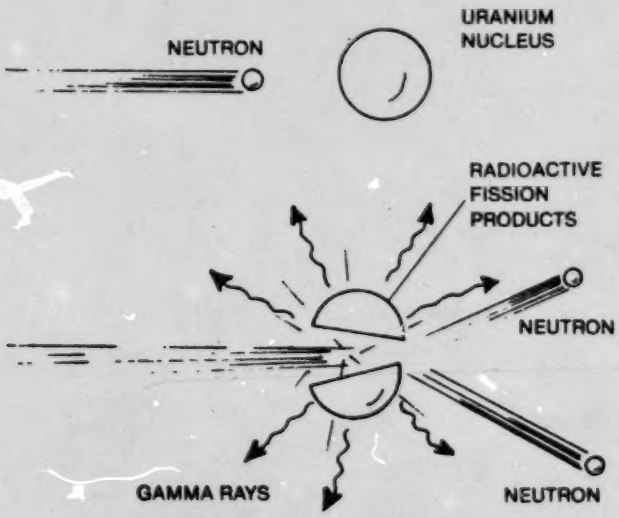


Figure 2
Fission Reaction

Figure 3

To create a fission chain reaction, it is necessary to bring together enough fissionable material, a "critical mass," so that the neutrons produced in the initial fission reaction do not escape, but rather produce more and more fission reactions until a self-sustaining chain reaction is produced.

In 1942, six months after the start of the Manhattan Project, an Italian physicist named Enrico Fermi succeeded in creating the first man-made nuclear chain reaction in a squash court beneath the stadium of the University of Chicago. On July 16, 1945, with the explosion of "Trinity," the first atomic bomb, the unleashed power of the atom made its way out of the laboratory and into the world at large.

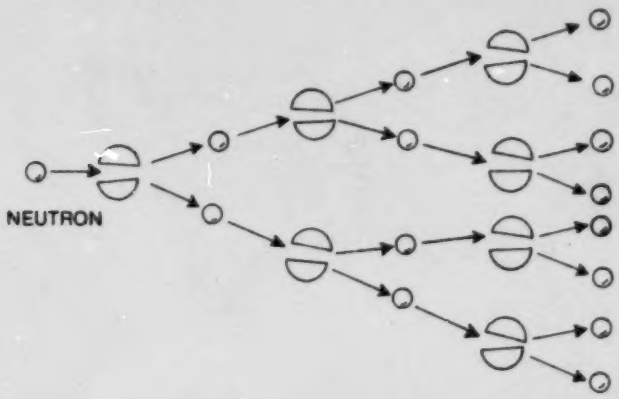


Figure 3
Fission Chain Reaction

Figure 4

A nuclear fusion reaction is actually the opposite of a fission reaction, though both produce energy in the form of high-speed neutrons and radiation. While fission involed splitting a single heavy atomic nucleus, fusion works by fusing together two light nuclei. In a fusion reaction, which is the basis for a hydrogen bomb, nuclei must be driven into one another with such force that the repulsion between the positive protons in the two neclei is overcome, allowing the nuclei to fuse together.

In a hydrogen bomb, also known as a thermonuclear or fusion bomb, a core of deuterium and tritium is ignited by the explosion of a small atomic (i.e. fission) bomb. In most nuclear weapons, the fusion bomb is surrounded by a shell of uranium 238 which is in turn ignited by the fusion explosion. Thus most nuclear weapons can be characterized as "fission-fusion-fission" bombs.

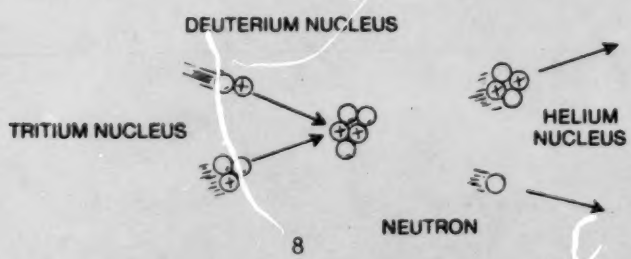


Figure 4
Fusion Reaction

LESSON ONE: Discussion Questions

1. Why is a nuclear explosion so much more powerful than a conventional bomb? How much more powerful it it?

2. How can a nuclear explosion contaminate air and water in places far from the actual explosion?

3. If a nuclear bomb exploded in your town, why would a bomb shelter not necessarily be safe even if you were able to reach one in time?

4. What were the arguments for and against dropping the atomic bomb on Japan? What do you think you would have recommended?

5. After the first atomic bomb exploded, Albert Einstein said, "the unleashed power of the atom has changed everything except our way of thinking." What do you think he meant by that?

LESSON TWO The US-USSR Arms Race - A Time Line

A. 1946 - 1950

1) Atomic Energy Commission. The United Nations appoints leading scientists to do a study on nuclear weaponry and to attempt international control of atomic energy. This attempt proves unsuccessful.

2) Baruch Plan. The U.S. proposes international control of nuclear weapons, but the plan is rejected by the Soviet Union.

3) The U.S. begins a major push in technically sophisticated weaponry; beginning of weapons testing in South Pacific.

4) The Soviet Union attempts to match U.S. military might.
   a. Begins mobilizing vast armies heavy in traditional weaponry.
   b. Explodes first atomic bomb (which is too big for airplane delivery) in 1949.

B. 1951 - 1955

1) The U.S. debates development of the hydrogen bomb, "the Super Bomb," creating a split in the American scientific community.
   a. Edward Teller leads a minority of scientists supporting development of the hydrogen bomb.
   b. J. Robert Oppenheimer, Enrico Fermi, and the General Advisory Committee of the Atomic Energy Commission oppose it unanimously.
   c. President Truman supports development of hydrogen bomb saying, "anything that assures us a lead in the field of atomic energy should be tried out."
   d. In 1952, the United States tests its first hydrogen bomb in the Pacific and concern over the effects of radioactive fallout from such testing begins.

2) The Soviet Union develops its first intercontinental long-range bomber, "The Bison."

3) The first Soviet H-Bomb is tested in 1953, much earlier than the U.S. had expected.

4) The U.S. and most Western European nations join together to form NATO, the North Atlantic Treaty Organization, as a means of protecting Western Europe against Soviet aggression.

C. 1956 - 1960

1) The Soviet Union
   a. The U.S.S.R. successfully tests the first intercontinental ballistic missile.
   b. The US-USSR missile and space race begins with the Soviet launch of Sputnik in 1957.

2) The United States
   a. Soviet advances spur U.S. civil defense programs.
   b. After initial failure, the U.S. launches its first satellite, Explorer I, in January, 1958.
   c. Despite the clear U.S. lead in weapons and missiles, the so-called "missile gap" becomes an issue in John F. Kennedy's presidential campaign.

d. The U.S. increases its ICBM development programs and designates greatly increased funding for research in engineering, math and science in response to the Soviet advances.

D. 1961 - 1965

1) The Soviet Union deploys the first land-based intercontinental ballistic missiles (ICBM's). Also explodes a 50 megaton hydrogen bomb, the largest explosion ever, three thousand times more powerful than the bomb used in Hiroshima.

2) In the United States,
   a. John F. Kennedy is elected President and pushes for greater funding for missile systems production.
   b. The first submarine-launched ballistic missiles (SLBM's) are deployed on Polaris submarines in 1960.
   c. The first missiles capable of reaching the Soviet Union from the U.S. (ICBM's) are developed.

3) The Cuban Missile Crisis occurs when the Soviet Union places missiles with nuclear warheads in Cuba. In light of U.S. nuclear arms superiority, the Soviets are forced to withdraw. The Soviet Union vows to catch up to the United States in nuclear weapons.

4) The 1963 Limited Test Ban Treaty prohibits all weapons testing in the atmosphere, under water, and in space. Only underground tests permitted. This is the first treaty on nuclear weapons between the U.S. and the Soviet Union.

E. 1966 - 1970

1) The United States continues to develop new weapons capabilities, including MIRV's, or "Multiple Independently-targetable Re-entry Vehicles." This name refers to the ability to independently target many different warheads on one missile, thereby increasing greatly the destructive force of each missile.

2) The Soviet Union engages in a massive buildup of ICBM's and deploys its first SLBM's.

3) The 1968 Non-Proliferation Treaty represents the first attempt to control the spread of nuclear weapons beyond the five countries which then had them: U.S.A., U.S.S.R., France, Britain, and China.

4) SALT I is the first in a series of Strategic Arms Limitation Talks, as well as an attempt to establish a more constructive relationship with the Soviets -- 1969.

F. 1971 - 1975

1) SALT I is signed and ratified by the U.S. and the Soviet Union in 1972.
   a. Its major accomplishment was to stop the development of anti-ballistic missile systems which would have greatly de-stabilized the arms race.
   b. It also placed ceilings on certain missile systems on both sides.

2) The Soviet Union continues modernization and expansion of its missiles and warheads, particularly through MIRVing of existing missiles to catch up with MIRVing already done by the U.S.

G. 1976 - 1980

1) In response to the Soviet buildup, the U.S. begins to look for ways to protect its missiles from possible Soviet attack.
   a. The MX missile is developed and controversy arises about how to base it so it is invulnerable to attack.
   b. Plans are developed for a more powerful and invulnerable submarine, the "Trident."

2) The Soviet Union continues modernization of its nuclear forces.
   a. Submarines are MIRVed.
   b. Intermediate-range missiles that can reach Europe are MIRVed and deployed.

3) Arms control efforts between the superpowers continue in SALT II, but the treaty agreed on by negotiators fails to gain ratification in the U.S. Senate.
   a. Fears about the terms of the treaty lead some to oppose it as unfair or as inadequate.
   b. The Soviet invasion of Afghanistan sours U.S.-Soviet relations and dooms the treaty to failure in the Senate.

H. 1981 - Present

1) The U.S. and the Soviet Union exchange accusations about who is responsible for the nuclear arms race, but also agree to conduct two new sets of negotiations on arms reductions.
   a. START, or Strategic Arms Reduction Talks, are proposed by President Reagan soon after he takes office. In general, START is SALT renamed, but with a somewhat different strategy. The START negotiations focus on the long-range or strategic weapons of the two superpowers.
   b. INF, or Intermediate-range Nuclear Forces negotiations, are an attempt to limit shorter range missiles, chiefly those in the European theater.

LESSON TWO: Relevant Quotes

After the defeat of Nazi Germany and Japan, both the United States and the Soviet Union drastically cut back their standing armies. Tensions in the wartime alliance soon blossomed into full-fledged hostility, however, and the arms race began. From the beginning both sides concentrated on what they were good at: the Soviets mobilized vast armies heavy in artillery and tanks, while the U.S. developed technologically sophisticated weaponry, which meant atomic bombs and the means to deliver them.

Atomic bomb production in the United States did not stop with the Japanese surrender, and our late August 1945 inventory of one lone bomb was soon joined by others. By the end of the year we were producing enough fissionable material to make two or three bombs a month. By 1950, the U.S. stockpile was on the order of "several hundred" weapons . . . .

Then, in August of 1949, the Soviet Union exploded its first atomic bomb. While the device was probably too big to be dropped by any Soviet airplane then in existence, it signaled the beginning of the end of the U.S. monopoly on nuclear weapons.

All the experts had thought that the Soviet bomb was two years to a decade away. The U.S. response to its sudden appearance provides the first clear example of the action-reaction phenomenon in the nuclear age. . . . The immediate result of the Russian bomb was Truman's decision to build the hydrogen bomb and to speed production of the B-36 bomber. We built a bomb, then the Russians built a bomb, then we built a bigger bomb -- and so it went. . . .

At the 1954 May Day celebration in Moscow, the Soviets unveiled the Bison, their first intercontinental bomber. . . . For the first time since the British sacked Washington, D.C., in the War of 1812, the U.S. had become vulnerable to foreign attack. . . .

In August of 1957 the Soviet Union successfully tested the first ICBM. Two months later, in October 1957, the same booster was used to launch into orbit Sputnik, the first man-made satellite. The immediate effect of this Soviet success was to shift U.S. concern from Soviet bombs to Soviet missiles. The reaction of the United States' military establishment was dramatic. Within two years U.S. intermediate-range ballistic missiles were placed in Turkey, Germany, Italy, and Great Britain, from which they could reach the Soviet Union. The U.S. ICBM program also received a big boost, and by 1960 more than a hundred Atlas ICBM's had been deployed at sites in the United States. . . .

The vulnerability of the United States to missile attack became a central issue in the 1960 U.S. presidential campaign after Democratic nominee John Kennedy claimed that a "missile gap" had been allowed to emerge while the White House was in complacent, budget-conscious Republican hands. At the same time, the intelligence analysts were predicting that hundreds of missiles would soon be targeted on the United States. After his election, Kennedy successfully pushed for dramatic increases in spending on our own strategic missile programs -- ICBM's and the Polaris submarine-launched

ballistic missiles. . . .

By 1965, it was clear that the United States and the Soviet Union were embarked on a competition in numbers of nuclear weapons and delivery systems for which there was no end in sight. . . . The all-out missile competition provided the setting for the Strategic Arms Limitation Talks (SALT) and the beginning of detente -- the effort to establish a more constructive relationship with the Soviet Union. President Johnson first proposed arms talks at a meeting with Premier Kosygin in 1967, and the two nations formally opened the negotiations in Helsinki, Finland, in the fall of 1969, Richard Nixon's first year in office.

The 1960's had begun with the United States holding a formidable 5,000-to-400 advantage over the Soviet Union in nuclear warheads deliverable to the territory of the other side. The U.S. also led in missiles -- 125 SLBM's and ICBM's to Russia's fifty. At the end of the decade the United States still enjoyed a substantial lead in intercontinental bombers (600 to 150), SLBM launch tubes (656 to 205), and total warheads (6,000 to 1,000). The Russians, however, had pulled ahead in ICBM's (1,350 to 1,054) and in total megatonnage (the combined explosive force in their nuclear arsenal). In addition, the Soviet ICBM's carried a larger payload (or "throw-weight"), raising fears among U.S. analysts that the Soviets would MIRV their big missiles with large numbers of warheads.

While the arsenals of the two superpowers were growing rapidly, negotiations proceeded slowly. The major achievement of this period was the 1968 signing of the Nonproliferation Treaty, the first step toward controlling the spread of nuclear weapons beyond the five countries which had already developed them -- the United States (1945), the Soviet Union (1949), Great Britain (1952), France (1960), and China (1965). . . .

The SALT I negotiations concluded in May 1972 with Leonid Brezhnev and Richard Nixon signing the SALT I agreements -- the first major treaty limiting arms since the 1920's. . . .

When SALT II was signed in 1979, it put limits on many categories of arms competition but did nothing to achieve deep reductions in nuclear arms . . . In thirty-seven years of nuclear arms competition, the weapons builders had achieved one triumph after another. The negotiators have signed only a few peripheral agreements, and even those are now threatened. Thus it might be fairly said that the decade of the 1980's began, once again, on square one.

Nuclear War: What's in it for You?, Ground Zero.

A salient fact about America's role in the nuclear age is that it has been hobbled by a twin paradox. Its defense policy has focused around a weapon that is all-powerful, but, at least at the present, can't be used. Yet, on the other hand, to pursue this policy, it has set in motion a process which propels it toward the ultimate use of nuclear weapons by the United States as well as their use against the United States. Nothing like this has ever happened in recorded history. A nation that scored a technological breakthrough in the past -- a superior naval vessel, a tank, an airplane, heavier artillery -- ordinarily gained political and military advantages from it. But while the 8,000 megatons of bombs in the U.S. stockpile constitute more

firepower than all the nations in all prior history have collectively assembled, and can kill all four billion people on earth a dozen times over, they cannot assure victory because their use invites certain annihilation in return. The general estimate by such experts as McNamara and Schlesinger is that no matter who presses the button first there will be between 95 and 120 million dead on each side. "Victory" therefore becomes the ultimate defeat, but such is the nature of the nuclear race that this must constantly be risked.

-- The Day Before Doomsday, Sidney Lens.

LESSON TWO: Learning Aids

MILESTONES IN THE NUCLEAR ARMS RACE

The dynamics of the nuclear arms race ensure that development of a new weapons system by one power will in a relatively brief period be followed by a comparable achievement by the other. Both powers have had "firsts." Neither has stayed ahead for long in any category.

US - 1945 ATOMIC BOMB 1949 - USSR

The nuclear age began with the explosion of a US A-bomb of 12.5 kilotons (equivalent to 12,500 tons of TNT) over Hiroshima, Japan. The single bomb, which destroyed the city, introduced to the world a concentrated explosive force of unprecedented power. Within four years, the USSR conducted its first atomic test.

US - 1948 INTERCONTINENTAL BOMBER 1955 - USSR

By 1948, the US had begun to replace the propeller planes of World War II with long-range jets. The first planes developed for strategic (intercontinental) bombing required refueling to reach another continent. In 1955, the US began deployment of the all-jet intercontinental bomber, and the USSR soon followed suit.

US - 1952 HYDROGEN BOMB 1953 - USSR

The H-bomb multiplied the explosive force of the A-bomb 1,000 times. The first US thermonuclear bomb had a yield equivalent to 15,000,000 tons of TNT; a year later the USSR tested a bomb in the million-ton range.

USSR - 1957 INTERCONTINENTAL BALLISTIC MISSILE (ICBM) 1958 - US

Following intensive development by both nuclear powers, a land-based missile to carry nuclear warheads intercontinental distances was successfully flight-tested by the USSR in 1957, and by the US a year later.

USSR - 1957 MAN-MADE SATELLITE IN ORBIT 1958 - US

Sputnik I by the USSR initiated a space race which quickly took on military functions; the first US satellite was launched into orbit the following year. Well over half the superpowers' satellites have been military: for surveillance, targeting, communications, etc.

US - 1960 SUBMARINE-LAUNCHED BALLISTIC MISSILE (SLBM) 1968 - USSR

A nuclear-powered submarine which could fire long-range missiles from a submerged position was the third means of strategic delivery. The US produced the nuclear-powered Polaris, with missiles with a range of 1,200 nautical miles. Eight years later the USSR had comparable nuclear subs.

USSR - 1968 ANTI-BALLISTIC MISSILE (ABM) 1972 - US

The USSR deployed 64 defensive missiles around Moscow. The US began construction of the Safeguard system in 1969 and had one site completed when a treaty restricting ABM's was signed in 1972. Generally judged militarily ineffective, ABM's were restricted to one site in each country in 1974. Subsequently the US site was closed.

US - 1970 MULTIPLE INDEPENDENTLY-TARGETED WARHEAD (MIRV) 1975 - USSR

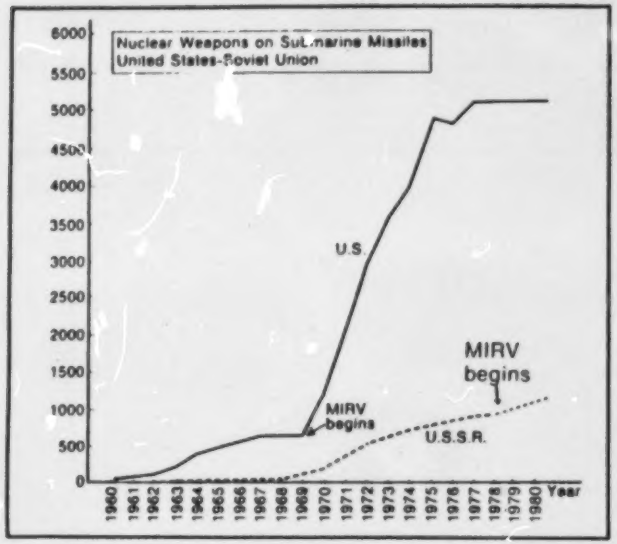
Development of multiple warheads enabled one missile to hit three to ten individually selected targets as far apart as 100 miles. USSR began to flight-test MIRV's three years after US put them in service and in 1975 began deployment.

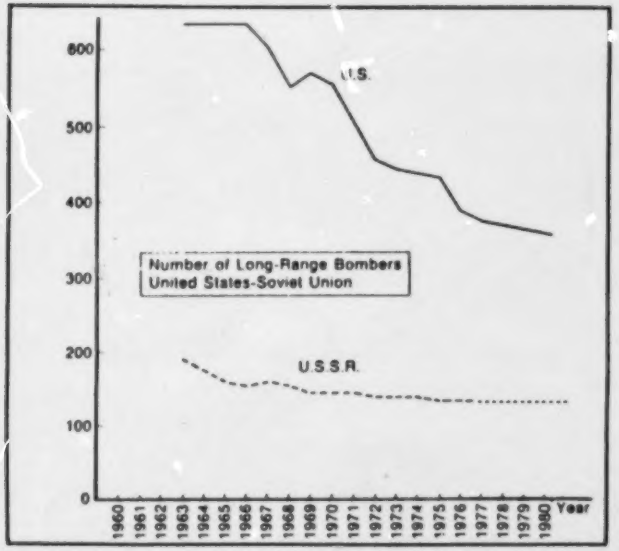
US - 1982 LONG-RANGE CRUISE MISSILE 198? - USSR

The cruise missile is small, relatively inexpensive, highly accurate, with the unique advantage of very low trajectory. Following the contours of the earth, and flying under radar, it will be able to destroy its target without warning. The US is reportedly 7-8 years in the lead in this technology.

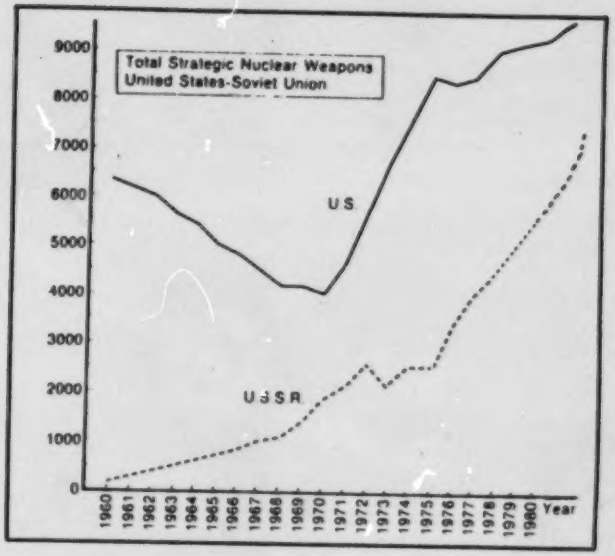
SOURCE: Ruth Sivard, World Military and Social Expenditures, 1981.

Measures of the Nuclear Arms Race





Measures of the Nuclear Arms Race



LESSON TWO: Discussion Questions

1. Since we were allied with the Russians in World War II, why did we immediately embark on an arms race with them after the war?

2. Why did "civil defense" become a big issue in the United States in the 1950's?

3. How successful have the arms control treaties been in slowing down the arms race?

4. In what categories of weapons development has the United States been first in the nuclear arms race? In what ways has the Soviet Union been first?

5. What is meant by MIRV? Why is development of MIRVing important?

6. From an examination of the nuclear arms race so far, does it appear to you that one side or the other can ever get decisively ahead?

LESSON THREE Where Are We Now?

A. Six countries are currently known to have nuclear weapons:

1) United States (since 1945)
2) U.S.S.R. (since 1949)
3) Great Britain (since 1952)
4) France (since 1960)
5) China (since 1964)
6) India (since 1974)

B. The United States and the Soviet Union posses 98% of these weapons and a rough balance of nuclear weapons capability now exists between these two superpowers -- each can deliver over 7,500 nuclear warheads on the other side in a matter of hours.

C. Both the Soviet Union and the United States rely on what are called "Strategic Triads" to deter the other side from aggression.

1) A Triad means having three different types of delivery systems for nuclear warheads -- land-based missiles, submarine-based missiles, and airplanes.

a. Intercontinental ballistic missiles (ICBM's)
b. Submarine-launched ballistic missiles (SLBM's)
c. Bombers

2) The purpose of a Triad is to guarantee that some delivery systems will always survive a surprise attack.

D. The comparative sizes of the various parts of the U.S.-U.S.S.R. Strategic Triads are:

	Delivery Systems		Warheads (Bombs)	
	USA	USSR	USA	USSR
ICBM's	1052	1400	2150	5500
SLBM's	632	950	5000	1750
Bombers	348	140	3500	300
	2032	2490	10600	7550

E. Both the United States and the Soviet Union have the capacity to almost totally destroy the other country -- even if one were the victim of a surprise attack by the other side.

1) Many weapons on both sides -- particularly those on bombers and submarines -- are invulnerable to a surprise attack.
2) Both superpowers could kill as many as 100 million people in the other country after absorbing a surprise attack.
   a. One U.S. submarine, for instance, can single-handedly destroy 160 cities in the Soviet Union.
   b. The United States has about thirty submarines with that capacity.
3) Military strategists call this ability to destroy each other Mutual Assured Destruction, or MAD.

F. Does this Mutual Assured Destruction guarantee that there will be no nuclear war? Unfortunately, it does not.

1) This destructive capacity makes a surprise nuclear attack highly unlikely, but it does not make nuclear war impossible.

2) In addition to the possibility of a surprise attack, there are at least four other ways that a nuclear war could start:
   a. Escalation of a conventional war in Europe.
   b. Escalation of a war between Third World countries.
   c. An accidental war that occurs as the result of a computer or human error.
   d. A war that starts after terrorists obtain and use nuclear weapons.

G. The possibility that a nuclear war could start is greatly increased as more and more countries become able to make nuclear weapons.

1) People refer to this problem as "proliferation" -- that is, the spread of nuclear weapons to countries which haven't previously had them.

2) Many countries which do not have nuclear weapons have nuclear power plants and in some cases it is possible to manufacture nuclear weapons from the waste material created by the generation of nuclear power.

3) The following countries are interested in obtaining nuclear weapons and may well have them within ten years:
   a. Argentina
   b. Brazil
   c. South Korea
   d. Taiwan
   e. Iraq
   f. Libya
   g. Pakistan

4) Many other countries could have nuclear weapons in ten years, but at this point, it appears that they will not try to build them.

5) It is obvious even to the casual observer that the risk of nuclear weapons being used increases greatly as more countries get the bomb.
   a. What if Argentina had had the bomb during the Falkland Islands war?
   b. What if an unstable leader like Colonel Qaddafi in Libya had the bomb?
   c. What if Pakistan had nuclear weapons now that its rival India already has the capacity to make them?

H. Although deterrence (Mutual Assured Destruction) has kept the superpowers from going to war for over thirty years, much evidence points to the fact that deterrence alone will not always work.

LESSON THREE: Relevant Quotes

The era of armaments has ended, and the human race must conform its actions to this truth or die.

-- President Dwight David Eisenhower, 1956

Examining the capabilities of a single nuclear submarine reveals its incredible destructive potential. A Poseidon sub comes equipped with 16 missiles. Each missile can carry 10 or more warheads, each equivalent to 3 Hiroshima bombs, that can be directed to separate targets. (The Poseidon subs that have been retro-fitted with newer Trident I missiles have even more powerful warheads.) Altogether, the 160 bombs on a single Poseidon can drop the equivalent of more than 500 Hiroshimas on the Soviet Union. A single sub would therefore be capable of simultaneously attacking such cities as Moscow, Leningrad, Kiev, Tashkent, Baku, Kharkov, Gorky, Novosibirsk, Kuibyshev, and Sverdlovsk -- each having a population in excess of a million -- and still have at least 150 warheads available to wipe out other cities, villages and hamlets. This is the power of just one Poseidon sub, of which the United States has thirty-one.

-- Beyond the Freeze, Union of Concerned Scientists

At the moment, the strategic strength of both sides is roughly equal, and it is likely to remain so for some time. Even a major effort by one side or the other could not easily upset this balance. Both sides are embarking on large new weapons programs which tend to capture media attention and tend to distract from the real issue -- the existence of an arms race that we know is steadily increasing the risk of nuclear war but don't know how to stop.

-- Nuclear War: What's in it for You?, Ground Zero

The idea of strategic nuclear superiority and inferiority has no meaning. The important thing to remember is we both have thousands of nuclear weapons. There is nothing realistic about being ahead or behind when he has 6,000 and you have 9,000 and it only take 400 megatons to detroy a country.

-- Admiral Noel Gayler, U.S.N., Ret.

I would not for a moment exchange anything [with the Soviets] because we have an immense edge in technology.

-- Casper Weinberger, Secretary of Defense, April 29, 1982.

Missiles will bring anti-missiles, and anti-missiles will bring anti-anti-missiles. But inevitably, this whole electronic house of cards will reach a point where it can be constructed no higher.

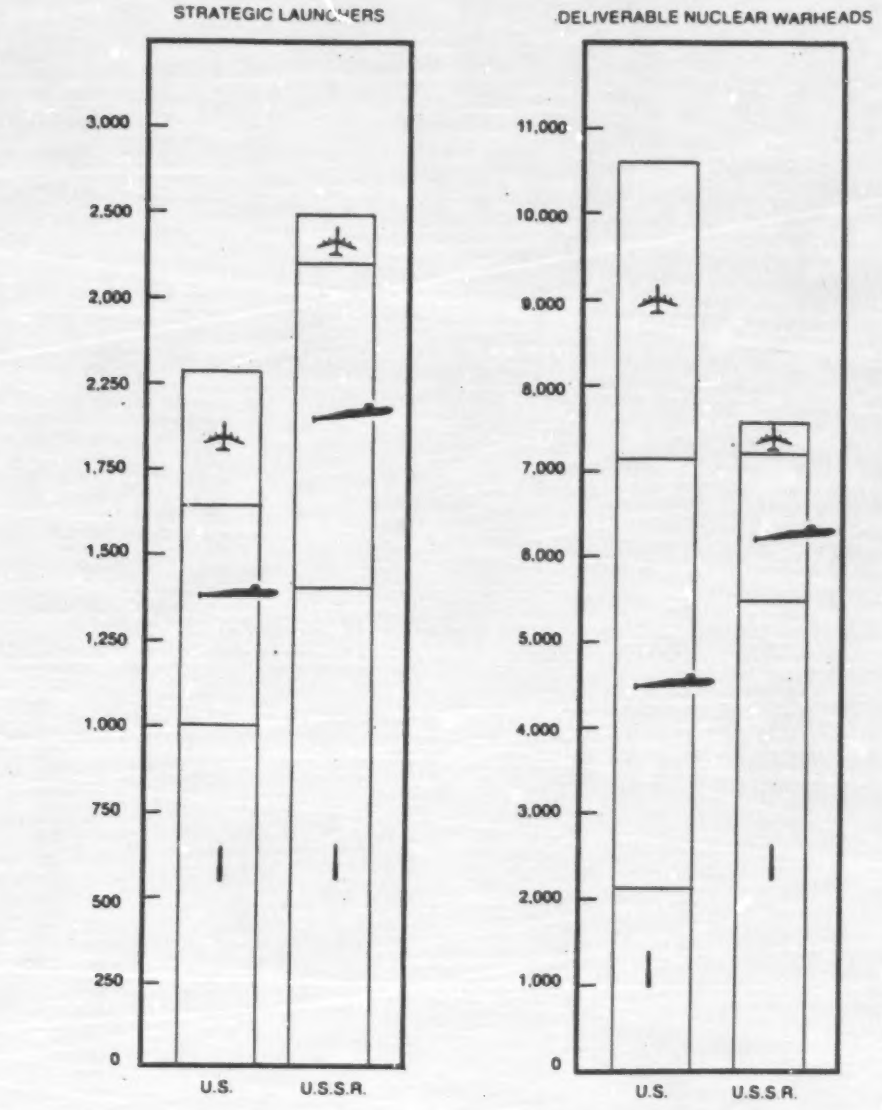
-- General Omar N. Bradley, 1957.

The argument against nuclear proliferation is a simple one: the greater the number of nations with nuclear weapons, the greater the chance of nuclear war -- including all-out war between the United States and the Soviet Union.

The problem is the law of averages -- the number of combinations. Think how many nations in the world are at odds with their neighbors: North Korea and South Korea, Pakistan and India, Iran and Iraq, Israel and the Arab states, South Africa and its neighbors. A complete list would be a long one. In several cases, these nations have already engaged in full-scale conventional ways -- and have by no means settled their differences. Indeed, many remain passionate enemies. What would happen if, in a future war, one of these nations used a nuclear weapon?

-- Nuclear War: What's in it for You?, Ground Zero.

Strategic Arsenals of the Superpowers



Long-range bombers

Submarine-launched ballistic missiles

Intercontinental ballistic missiles

The strategic forces of the U.S. and U.S.S.R. are represented here in two ways: (*left*) in terms of strategic nuclear delivery systems and (*right*) in terms of deliverable nuclear warheads (bombs and reentry vehicles).

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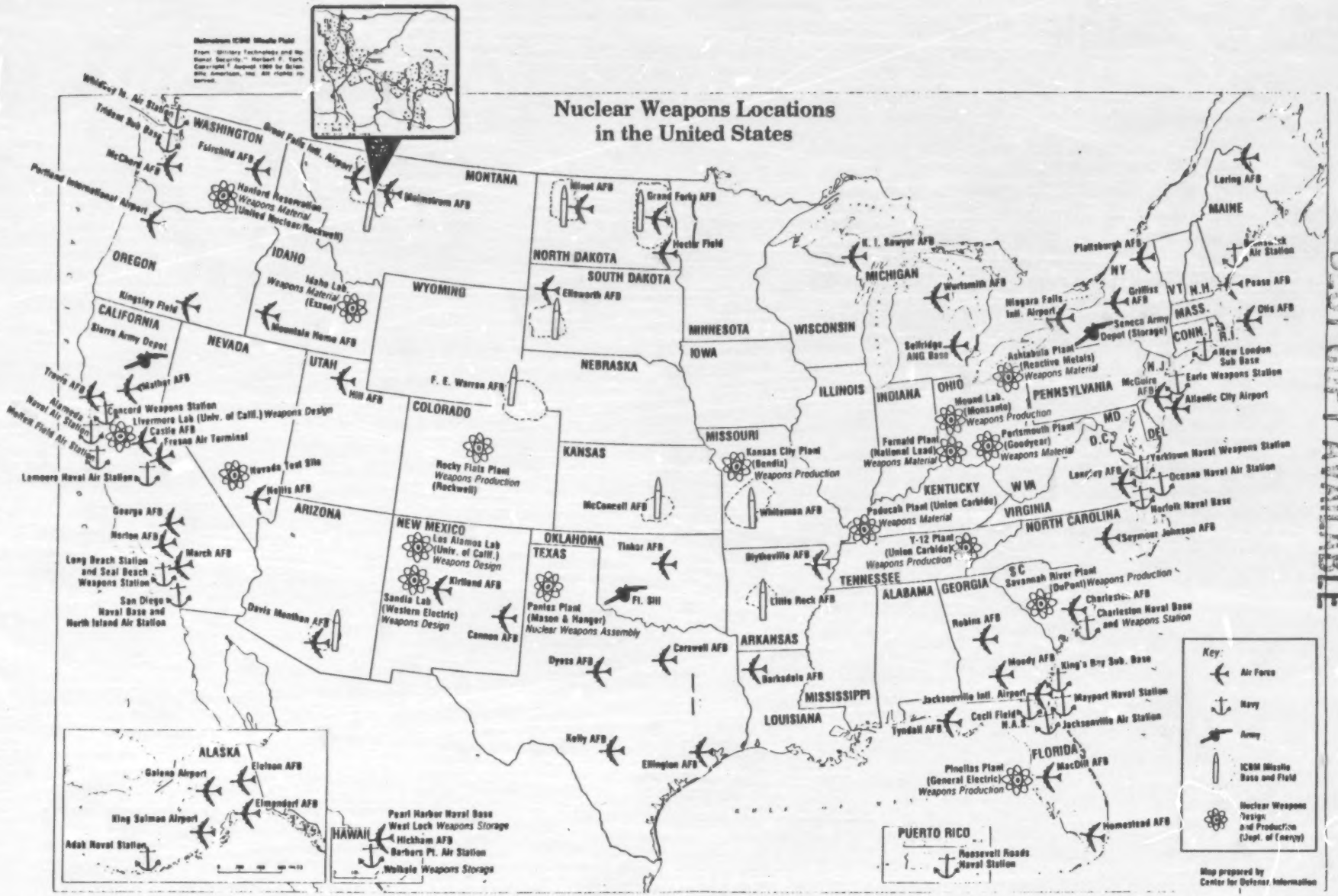

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LESSON THREE: Discussion Questions

1. What is the reason for having a "strategic triad?"

2. In what categories of nuclear weapons and delivery systems is the United States ahead? In which does the Soviet Union have an advantage?

3. What is mutual assured destruction? Do you think it is an effective way to prevent nuclear war in the long run?

4. How many countries have nuclear weapons now? What are some countries that could acquire them in the next ten years? How much more dangerous do you think the world would be if many more countries had nuclear weapons?

5. Which of the possible ways nuclear war could start seem most likely to you?

A. It is impossible to predict with certainty the effects of a nuclear war.

1) The degree of destruction would be determined by a number of factors, including:
   a. Whether it were a limited or a "general" (all-out) nuclear war.
   b. The kind of weapon detonation, either an air burst or a ground burst.
      1. An air burst would kill people and destroy building over a wider area, but produce little fallout.
      2. A ground burst would create fewer immediate casualties, but produce much more fallout.
   c. The accuracy of the delivery systems and the reliability of the weapons themselves.

2) There is no past history of nuclear war anywhere in the world; thus, we have no way of knowing what such a catastrophe would be like.

B. However, all experts agree that nuclear war would create a horror far beyond that produced by any other war in history.

1) Immediate casualties in the United States:
   a. Government estimates indicate that up to ten million people would be killed even if the attack were aimed only at U.S. missiles and bombers.
   b. And if the war included general attacks on cities, 100-140 million Americans would die immediately.

2) Immediate casualties in other countries:
   a. In the Soviet Union, casualties would be similar to those in the United States -- over 100 million Soviet citizens would die in an all-out nuclear attack by the United States.
   b. Europe would almost certainly have even more casualties in a general nuclear war.
   c. If China were attacked in a nuclear war, its casualties would be very high because of its high population density -- again, 100 million or more.

3) Long-term Effects
   a. Many millions of people in the United States, Europe, the Soviet Union, and other countries would die from radiation sickness caused by fallout in the months following the attack.
   b. Millions who escaped death from radiation sickness would die in future years from various forms of cancer caused by exposure to radiation.
   c. Millions of people around the world would starve to death because of the decimation of American agriculture, upon which much of the world depends.

4) Environmental Consequences
   a. Air, water and land would be contaminated.
   b. The ozone layer which protects the earth from the sun's ultra-violet rays could be severely damaged.
      1. If this happened, skin cancer would increase and people and animals could go blind from the unfiltered rays of the sun.

2. Some scientists believe that nuclear war could damage the ozone layer so badly that earth would no longer support human life.

5) Medical Consequences
   a. Increasing numbers of physicians say that there is no effective medical response in the case of nuclear war.
      1. A higher percentage of physicians would be killed than people in the population as a whole, because more physicians live in cities and cities are more likely targets than rural areas.
      2. Most hospitals would be destroyed.
      3. The number and severity of injuries would entirely overwhelm those physicians who did survive.
   b. Nuclear war would create horrible injuries which would largely go untreated.
      1. Injuries from the heat of the explosion.
         a. Even people many miles from the explosion would be burned.
         b. Firestorms kindled by the explosions would burn many more.
      2. Injuries from blast.
         a. Falling buildings would injure people.
         b. People would be hurled through the air by the blast.
      3. Illness from radiation.
         a. Severe illness would immediately affect people who had been exposed to high levels of radiation.
         b. Long-term effects of radiation would include an increase in the incidence of various kinds of cancer and other diseases.

C. Recovery from nuclear war would be difficult and perhaps even impossible.
   1) The civilized world as we know it would be destroyed in a general nuclear war.
      a. Water and food supplies, communications, industrial production, social services and many other aspects of modern society would be completely disrupted.
      b. Unlike other major disasters, there would be no outside world to help in rebuilding after a nuclear war; only the poorest countries, those too poor to help, would be spared direct attacks.

   2) The psychological problems stemming from a nuclear war are impossible to calculate, but they would undoubtedly be immense.
      a. Survivors would face the awesome task of rebuilding, but might not have the psychological or emotional resources necessary to meet such a challenge.
      b. An all-out nuclear war would create the most extensive incidence of general psychological disorientation in history.

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LESSON FOUR: Relevant Quotes

Now appears to be the time to say it again: the entire industrialized world could be destroyed in 24 hours through nuclear war. Everyone in his fifties or older saw this grim situation of opposing "deterrents" emerge during his adult life. Those in their forties or older remember real life nuclear war scenarios: the Berlin crisis and the open threats of nuclear use in the Cuban missile crisis.

But those in their twenties have largely escaped confrontation with this reality. And some of their elders may have forgotten it.

The situation, in brief, is this. One bomb can destroy one city. A large warhead with 25,000,000 tons of TNT equivalent (25 "megatons") will level homes 13 miles in all directions from its ground zero. The Soviet Union is ready to deliver 100 to 200 bombs of this size. One such bomb would level the largest city, e.g. New York. A five megaton bomb will do the same for cities with a radius of 7.5 miles. The Soviet Union is ready to deliver 400 such weapons. Warheads of about 1 megaton could level cities that are four miles in radius. The Soviet Union has 6,000 warheads in that range. The U.S. has only 2,000 cities over the minimal size of 10,000 persons. All of those could therefore easily be destroyed. . . .

The official estimates are that between 70 million and 160 million Americans would die -- and 20 to 30 million more if the Soviet Union's targeters really tried to kill people per se. America's population stands today at 226 million. Thus, 30% to 70% of the population would die promptly. Tens of millions more would die from non-existent medical care, from unchecked disease, from low temperatures when winter arrived, and from agriculture failures.

-- FAS Public Interest Report, Vol. 34, No. 2, February 1981.
Federation of American Scientists

In the first moments of a ten-thousand-megaton attack on the United States, flashes of white light would suddenly illumine large areas of the country as thousands of suns, each one brighter than the sun itself, blossomed over cities, suburbs, and towns. In those same moments, when the first wave of missiles arrived, the vast majority of the people in the regions first targeted would be irradiated, crushed, or burned to death. The termal pulses could subject more than six hundred thousand square miles, or one-sixth of the total land mass of the nation, to a minimum level of forty calories per centimeter squares -- a level of heat that chars human beings. (At Hiroshima, charred remains in the rough shape of human beings were a common sight.) Tens of millions of people would go up in smoke. As the attack proceeded, as much as three-quarters of the country could be subjected to incendiary levels of heat, and so, wherever there was inflammable material, could be set ablaze. In the ten seconds or so after each bomb hit, as blast waves swept outward from thousands of ground zeros, the physical plant of the United Sates would be swept away like leaves in a gust of wind. The six hundred thousand square miles already scorched by the forty or more calories of heat per centimetre squared would not be hit by blast waves of a minimum of five pounds per square inch, and virtually all the habitations, places of

work, and other man-made things there -- substantially the whole human construct in the United States -- would be vaporized, blasted, or otherwise pulverized out of existenve. Then, as clouds of dust rose from the earth, and mushroom clouds spread overhead, often linking to form vast canopies, day would turn to night. (These clouds could blanket as much as a third of the nation.) Shortly, fires would spring up in the debris of the cities and in every forest dry enough to burn. These fires would simply burn down the United States. When one pictures a full-scale attack on the United States, or on any other country, therefore, the picture of a single city being flattened by a single bomb -- an image firmly engraved in the public imagination, probably because of the bombings of Hirohima and Nagasaki -- must give way to a picture of substantial sections of the country being turned by a sort of nuclear carpet-bombing into immense infernal regions, literally tens of thousands of square miles in area, from which escape is impossible.

-- The Fate of the Earth, Jonathan Schell.

Nobody can comprehend the totality of the horror of a major nuclear war. But you can imagine how it might affect you. Just look around at your neighborhood, your environment, your friends, and your family -- and then start taking them away: your house, your car, the trees in your yard, the people next door, the library in town, the evening news on television, the bus to work, the supermarket, the phone calls to parents at Christmas. A major nuclear war would strip all that is familiar to you, and especially the "people" relationships of family and friends, would ever be the same again.

Imagine that you were one of the "lucky" ones -- one of the survivors. What would your life be like? Water and electricity would be cut immediately and indefinitely. If the attack came in winter, any shelter you could find would get cold quickly and stay cold. Communications would be confined to a small number of mobile radio systems. You woudn't know what was happening. How many cities were hit? Was the president alive? What about relatives living elsewhere -- had they survived? What about the Russians -- had they been hit too? How did the war start? Was it over, or would there soon be more bombs? You might never learn the answers to many of these questions.

If you were injured you would hurt, and you would probably hurt until you got better or died. The few surviving medical facilities would be overwhelmed by the massive numbers of injured. Most would never see a doctor and would receive no medication -- not even an aspirin.

The world as you know it would be gone. The world which followed would be different; no one can say exactly how. Most policement, firemen, and government officials would be dead or injured. Banks and bank records would be gone. Paper money would be worthless. All the things people worry about -- paying the mortgage, sending the kids to college, visiting parents, building a business -- would come to a halt for months at best, most likely for years, perhaps forever.

If you had anything at all -- a few cans of food, a blanket, a warm coat for your child -- somebody stronger might come and take it from you. You might even find yourself committing acts you would have once found deplorable in order to survive.

You would wonder what was falling from the sky.

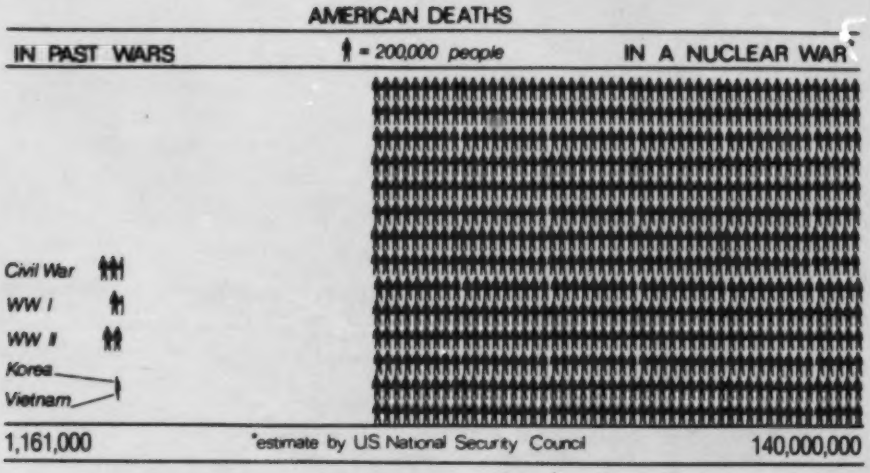
Every day for weeks you would see people die.

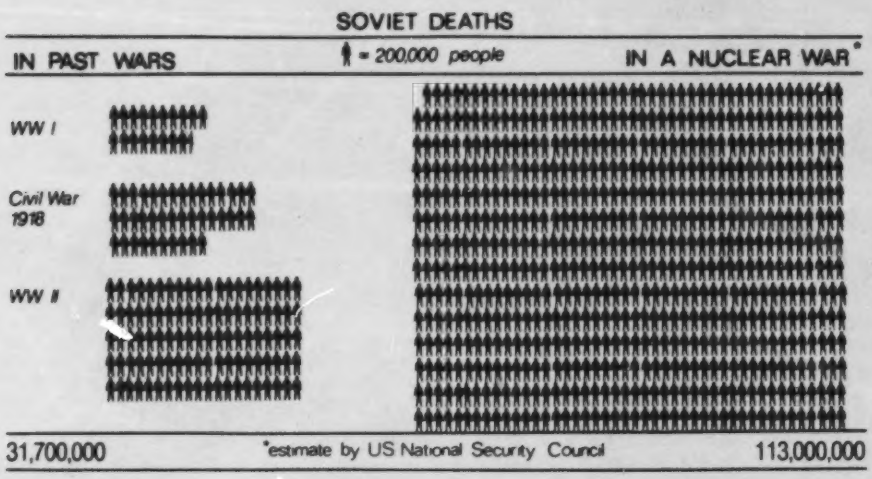
-- Nuclear War: What's in it for You?, Ground Zero.

In the immediate aftermath of a nuclear war, modern medical care would be impossible. There would be catastrophic damage to hospitals, power plants, transportation, and communication systems, compounded by severe shortages of food, water, and shelter. In addition, the electromagmetic pulse (EMP) caused by a nuclear explosion would probably burn out the electrical equipment in any surviving hostpirals. There would be no antibiotics, sterile dressings, blood plasma, or other necessary supplies. Most of the health care personnel would be among the injured or dead; at Hiroshima, 90% of the physicians and nurses were unable to provide medical care.

If a one megaton bomb were dropped on Detroit, there would be only 5000 beds in undamaged hospitals to treat the 500,000 injured. If the victims of such a blast could be tranported to hospitals through the entire United States (a highly unrealistic assumption), they would occupy fully 35% of the 1,407,000 beds available. There is no question that most injured persons would never see a doctor, and many would die without relief of pain.

-- The Medical Consequences of Nuclear War, The Harvard Medical School Nuclear War Study Group



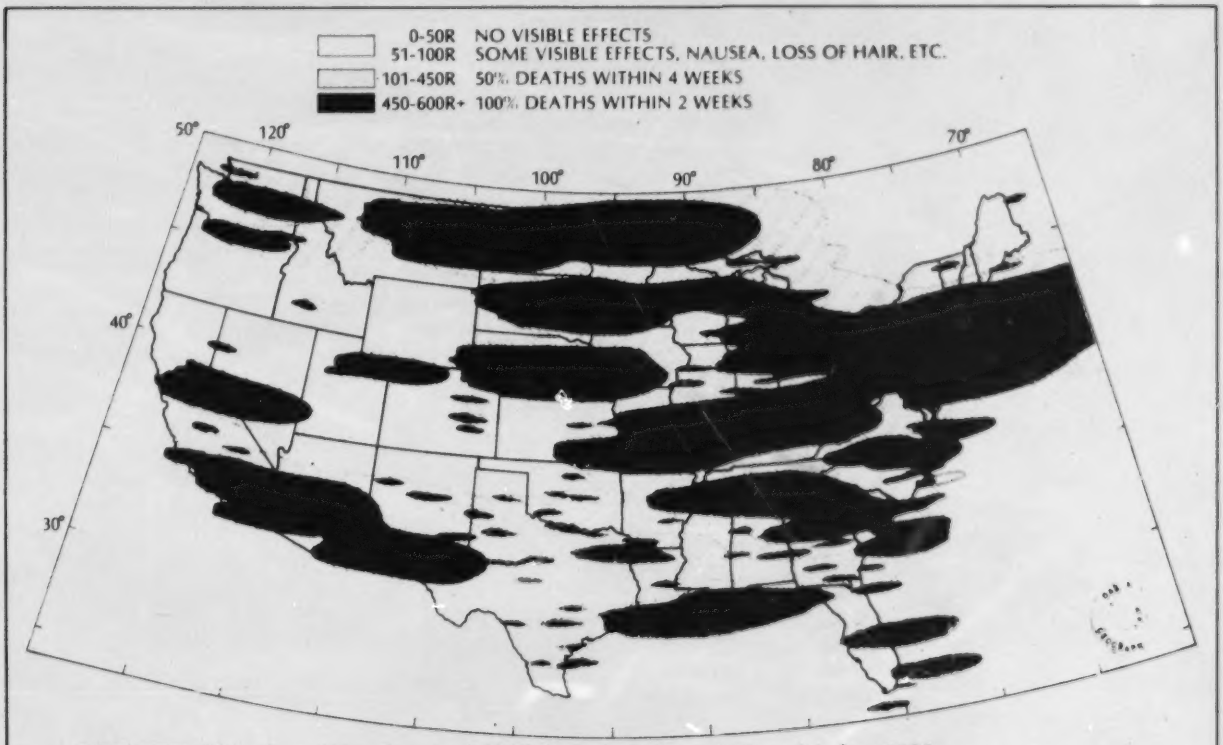


Predicted Nuclear Targets
Source: Federal Emergency Management Agency

The vaporized bomb material condenses and falls to earth as dust. This *fallout* emits radiation that can kill or injure. If you are exposed to a large dose, you will vomit, your skin will hemorrhage, you will bleed internally, and your hair will fall out. You probably will die within a month or two. A dose too small to cause immediate injury will weaken your body's defenses and increase the risk of infection, cancer, and birth defects.

Radioactive dust that rises high in the air is widely dispersed by winds. Most fallout will settle within a few weeks, but some will remain in the upper atmosphere for several years and spread over most of the world. Coarse radioactive dust from a ground burst settles quickly, most near the crater but some downwind in a diminishing plume. It can be fatal to unsheltered persons 50 miles away and dangerous at 200 miles.

The radioactivity of fallout declines rapidly, so the risk of *immediate* injury from radiation generally will disappear in one or two weeks, except downwind from craters. Since you cannot see, smell, or feel nuclear radiation, you will need a special radiation monitoring instrument to detect it.



SOURCE: *"Nuclear War Survival Skills"* Oak Ridge National Labs, 1979.

So ends the first but not the worst period for the survivors. The widespread destruction has stopped shipments of food, fuel, and medicine. Farming has halted. In undamaged areas, loss of electric power has disrupted water and communication systems. Police protection is severely limited. The few surviving doctors and nurses are overwhelmed by the sick and injured. Epidemics are starting. Most hospitals are destroyed. Fire control is hindered by lack of fuel and water. There is no disaster relief, no help from outside, no hope of rescue.

During the first few weeks after the attack, the corpses will be buried, burned, or abandoned. The epidemics will spread. The severely injured will be left to die. Fires will burn out. You will find food, water, and shelter or you will die.

SOURCE: Boulder County Nuclear War Education Handbook

LESSON FOUR: Discussion Questions

1. What effect would a nuclear war have on your city or town? From the maps included in this lesson try to judge whether it would be directly attacked or not. How much fallout would it receive?

2. How would the casualties of a nuclear war compare to those of past wars?

3. What would life be like for the survivors of a nuclear war? Someone once said that "the survivors would envy the dead." Do you think that is true?

4. What are some of the ways that a nuclear war would damage the environment? Which of these are most disturbing to you?

5. What medical care would be available after a nuclear war?

6. After a nuclear war, how many years do you think it would be before things would be back to the way they were before the war?

LESSON FIVE What Can Be Done To Prevent Nuclear War?

A. What Can Nations Do?

1) Promote education of citizens about how nuclear weapons have changed war and international relations.

2) Develop the wide variety of policies that will be necessary to prevent nuclear war in the long run.
   a. Careful study of the various ways nuclear war might start is essential to finding ways to prevent it.
   b. All of the resources that can be used as "firebreaks" to prevent nuclear war might be effectively used.
      1. Nuclear arms control
      2. Improved relations between the superpowers
      3. Nuclear nonproliferation
      4. Improved conflict resolution techniques
      5. Improved crisis communications between the superpowers
   c. Each scenario in which nuclear war could occur requires a different combination of firebreaks to prevent it; some firebreaks are important in defusing a crisis before it begins while others can be used once a crisis has been ignited.

B. What Can Individuals Do?

1) Learn about the issue.
   a. Begin with books, periodicals, films and pamphlets which give the basic information about nuclear weapons.
   b. Start a discussion group at your school, church, or club.
   c. Pay close attention to the developing issues by reading a daily newspaper or a weekly news magazine.
   d. Examine specific points of the issues by researching the areas that are most interesting or current.

2) Educate others.
   a. Share what you are learning by discussing it with friends and family.
   b. Organize a program for a group that involves an expert speaker or an interesting film.
   c. Join an organization that is working to prevent nuclear war.
   d. Encourage friends and family to have programs on nuclear war prevention in groups they belong to.

3) Act on your convictions.
   a. Write letters to a school or city newspaper expressing opinions about what our country should do to reduce the threat of nuclear war.
   b. Communicate with elected federal officials (the President, your two Senators, and your district's member in the House of Representatives) what you think and feel about nuclear weapons and nuclear war.
   c. Volunteer your time for a group or organization whose approach to preventing nuclear war you agree with.

d. Register to vote when you are old enough and make a federal candidate's positions on nuclear war prevention a factor in how you vote.
e. Distribute pamphlets, leaflets or brochures that give accurate information about nuclear weapons to members of groups you belong to or in a public place where people congregate.

C. Is It Possible to Prevent Nuclear War?

1) Although the threat of nuclear war is very real, it does not have to happen.
   a. The problem has been created by people -- it can be solved by people.
   b. We are free to choose our own future, but we must choose wisely.

2) If enough citizens become educated and involved, we can help our government find the necessary policies to keep such a horrible war from happening.
   a. The threat of nuclear war is the greatest challenge that American democracy has ever faced, but it is a challenge that can be met.
   b. What Daniel Webster said almost 150 years ago is still true today:

> Nothing will ruin the country if the people themselves undertake its safety, and nothing can save it if they leave that safety in any hands but their own.

LESSON FIVE: Relevant Quotes

Since the threat of nuclear war is henceforth to be an abiding fact of human existence, we have no choice but to learn to manage the threat and find ways to keep it under control. The community of nations -- and particularly the United States and the Soviet Union -- must develop a variety of means to keep nuclear weapons from being used. The challenge of doing that is enormous. It is nothing less than the greatest challenge that the human community has ever faced . . . . The task of preventing nuclear war is an awesome one. It requires utilizing a wide variety of resources effectively in countless different situations. It requires the institutionalization of a type of crisis management and international cooperation that is different from anything the world has ever seen. The very difficulty of the task may discourage many people from participating in the effort. At the same time, the horrible spectre of the threat may provide some hope for achieving the kind of breakthroughs in international problem-solving that are necessary to prevent nuclear war from ever occuring.

-- "Thinking About Preventing Nuclear War," Ground Zero

Controlled, universal disarmament is the imperative of our time. The demand for it by the hundreds of millions whose chief concern is the long future of themselves and their children will, I hope, become so universal and so insistent that no man, no goverment anywhere, can withstand it. . . . People in the long run are going to do more to promote peace than are governments. Indeed, I think that people want peace so much that one of these days, governments had better get out of their way and let them have it.

-- President Dwight David Eisenhower

Those who refuse to think about nuclear war because it is "too depressing" show by their response that they have already thought about it. Nuclear war is depressing, but the cure is not to deny the problem or to repress the depression; the problem will not go away by your refusing to think about it. And your anxiety will simply show itself in other ways. So, to cure yourself, start curing the world: get busy. The best -- perhaps the only -- cure for the nuclear war blues is not denial, depression or numbing, but rather action. A final cure will come only when the threat is removed. In the meantime, treating the symptoms out there in the world -- not in you -- is the best possible therapy.

Actually, there can be real zest in saving the world. What better way to spend your time? It sure beats sitting around moping, feeling sorry for yourself, wrapped up in petty disputes or worries. If you want to tackle a really big problem, something truly and totally worthwhile, something that can take your best efforts and still offer a challenge, then try your hand at saving the world. (Either part or full time, anyone may apply.) If you want "relevance" in your life, if you want to work with some of the finest people in the very best and most important cause imaginable, if you want to fill your life with more meaning than you ever dreamed possible --

then have we got a deal for you!

-- Stop Nuclear War! A Handbook, David Barash and Judy Lipton

One of the most common forms of the hope for deliverance from the nuclear peril by technical advances is the notion that the species will be spared extinction by fleeing in spaceships. The thought seems to be that while the people on earth are destroying themselves, communities in space will be able to survive and carry on. This thought does an injustice to our birthplace and habitat, the earth. It assumes that if only we could escape the earth we would find safety -- as though it were the earth and its plants and animals that threated us rather than the other way around. But the fact is that wherever human beings went there would also go the knowledge of how to build nuclear weapons, and, with it, the peril of extinction. Scientific progress may yet deliver us from many evils, but there are at least two evils that it cannot deliver us from: its own findings and our own destructive and self-destructive bent. This is a combination that we will have to learn to deal with by some other means.

-- The Fate of the Earth, Jonathan Schell

LESSON FIVE: Learning Aids

There are a number of organizations/agencies which offer materials which may be useful for further planning and study. These include:

Federal Government Agencies

Office of Technology
Publications Office
United States Congress
Washington, DC 20510

(202) 224-8996

Department of State
Public Information
Room 4827A
Washington, DC 20520

(202) 632-6575

Department of Defense
Office of Assistant of Secretary of
Defense for Public Affairs
The Pentagon
Washington, DC 20301

(202) 697-6648

Federal Emergency Management
Agency
500 C Street, S.W.
Washington, DC 20472

(202) 287-0300

Arms Control and Disarmament
Agency
320 21st Street, N.W.
Washington, DC 20451

(202) 632-7815

Non-Governmental Organizations Concerned with Nuclear War Prevention

Center for Defense Information
303 Capitol Gallery West
600 Maryland Avenue, S.W.
Washington, DC 20024

(202) 484-9490

Ground Zero
806 15th Street, N.W.
Suite 421
Washington, DC 20005

(202) 638-7402

Federation of American Scientists
307 Massachusetts Avenue, N.E.
Washington, DC 20002

(202) 546-3300

Physicians for Social Responsibility
23 Main Street
Watertown, Massachusetts 02172

(617) 924-3468

Arms Control Association
11 Dupont Circle, N.W.
Suite 900
Washington, DC 20036

(202) 546-7100

SANE
711 G Street, S.E.
Washington, DC 20003

(202) 546-7100

Council for a Livable World
11 Beacon Street
Boston, Massachusetts 02108

(617) 742-9395

Union of Concerned Scientists
1384 Massachusetts Avenue
Cambridge, Massachusetts 02238

(617) 547-5552

American Security Council
499 South Capitol Street, S.W.
Washington, DC 20003

(202) 484-1676

Committee on the Present Danger
1800 Massachusetts Avenue, N.W.
Suite 601
Washington, DC 20036

(202) 466-7444

American Enterprise Institute
1150 17th Street, N.W.
Washington, DC 20036

(2[illegible] 862-5800

Heritage Foundation
513 C Street, N.E.
Washington, DC 20002

(202) 546-4400

Addresses of Federal Elected Officials

President Ronald Reagan
The White House
Washington, DC 20500

Senator _____
United States Senate
Washington, DC 20510

Representative _____
House of Representatives
Washington, DC 20515

LESSON FIVE: Discussion Questions

1. List and then discuss some specific things that could be done in your town to educate people about the threat of nuclear war.

2. What projects could be undertaken by your class to make a contribution to preventing nuclear war?

3. What do you think the chances are (in percentage terms) that there will be a nuclear war before the year 2000? Do you think that these odds would be considerably reduced if millions more Americans paid attention to this threat and worked to help prevent it?

4. What are some other terrible threats that the United States has faced in the past? Give some examples of how citizens made a difference in each of those situations.

5. Some people have said that citizens have a role to play in domestic political issues, but that they should stay away from trying to influence foreign policy and national security issues. Do you agree with that? Why or why not?

SUGGESTED LEARNING EXERCISES

I. Have a debate among two teams of students on a topic relating to nuclear weapons and the threat of nuclear war. Possible topics include:

* Should the United States have dropped the first atomic bombs on Hiroshima and Nagasaki?
* Is a nuclear war winnable?
* The more nuclear weapons a country has the greater is their national security.
* Is limited nuclear war possible?
* Accidental nuclear war -- is it possible?

II. Have a panel discussion in which a group of students do research and present information on various aspects of topics such as those listed below:

* Life after nuclear war -- what would it be like?
* How nuclear war might start.
* A history of U.S.-Soviet relations.
* How have nuclear weapons changed war?
* The effects of nuclear war on your city, state, and on the nation as a whole.
* The problem of nuclear proliferation.

III. Have students research the effects of nuclear war on their city and prepare a map of what it would be like if a one-megaton bomb exploded in the middle of town.

IV. Surveys and polls about nuclear weapons and nuclear war are a good way to learn about people's attitudes and engage them in discussion. Students could develop a questionnaire and poll fellow students or citizens in their community about any of the following topics:

* Civil defense -- is it worthwhile in a nuclear war?
* Attitudes about the Soviet Union.
* What is the likelihood of a nuclear war before the year 2000?
* What steps do people think should be taken to reduce the threat of nuclear war?
* What are the most likely ways nuclear war might begin?

V. Have a contest in your class where students make presentations on a topic related to nuclear war using one of the following genres:

Poetry
Essay
Oratory
Drawing
Song writing

VI. Students can interview community leaders (politicians, business leaders, clergymen, civic leaders, educators, etc.) about their views on how to prevent nuclear war and then report to the class. Students may wish to invite some of the more interesting persons interviewed to come to the class for a presentation and discussion.

VII. Term papers are an excellent way to involve students in more detailed research. A wide variety of topics are possible for a standard term paper or for extra credit projects.

VIII. Students can role-play various points of view on the issue of how to prevent nuclear war. Have students pair off and then ask them to role-play the two different sides of the points of view listed below. After the two different sides have been represented, have them switch and role-play the other point of view.

* Soviet vs. American point of view as to who is to blame for the arms race.
* The point of view of one who believes the best way to prevent nuclear war for the U.S. to build more weapons vs. the person who believes the best way to prevent nuclear war is to stop building nuclear weapons.
* The person who believe civil defense is valuable against nuclear war vs. the person who believes it is of no value and only encourages war.

IX. Have students write a letter to the President or to their representatives in Congress expressing their views about the threat of nuclear war. Students can share and discuss the responses they recieve.

BIBLIOGRAPHY

Center for Defense Information. Nuclear War Prevention Kit. 303 Capitol Gallery West, 600 Maryland Avenue, S.E., Washington, DC 20024 (202) 484-9490.
A practical guide to how individuals and groups can influence U.S. decisions concerning nuclear policies; includes lists of films, slide shows, books, sample press releases, letters, TV and radio spots. $1.00.

Common Cause. Citizens Action Guide. 2030 M Street, N.W., Washington, DC 20036. (202) 833-1200. Free.
Gives practical tips on how citizens can get involved in the political process.

Ground Zero. Thinking About Preventing Nuclear War. 806 15th Street, N.W. Suite 421, Washington, DC 20005 (202) 638-7402. 25¢.
20-page pamphlet on the routes that could lead to a full-scale nuclear war between the U.S. and the U.S.S.R. and ways that nuclear war can be prevented.

Ground Zero. Nuclear War: What's in it for You? New York: Pocket Books, 1982. Available from Ground Zero, address above, $2.95.
A primer giving the basic information about the history of nuclear weapons, the probable consequences of a nuclear war, arms control efforts in the nuclear age, and possible routes out of the nuclear dilemma.

Keyes, Ken, Jr. The Hundredth Monkey. A Bantom Book, $2.95.
Easy to read, suitable for all ages, with a spiritual message.

The League of Women Voters. Security Through Arms Control. 1730 M Street, N.W., Washington, DC 20036. (202) 296-1770.
The League also has dozens of other publications on how to be politically effective.

Lens, Sidney. Day Before Doomsday: An Anatomy of the Nuclear Arms Race. New York: Doubleday & Co., Inc., 1977.
A comprehensive discussion of nuclear arms race issues.

Physicians for Social Responsibility. The Final Epidemic: The Medical Consequences of Nuclear Weapons and Nuclear War. Chicago: Educational Foundation for Nuclear Science, 1981.
Transcripts from PSR symposia on medical effects of nuclear war.

Schell, Jonathan. The Fate of the Earth. New York: Knopf, 1982.
A compelling and eloquent overview of the problem of nuclear war, with special emphasis on the possibility of extinction.

U.S. Arms Control and Disarmament Agency. The Effects of Nuclear War. Department of State, Washington, DC 20451, (202) 632-3597. 1979.
Also has material on previous treaties, U.S.-U.S.S.R. relations, non-proliferation, SALT, comprehensive test ban.

U.S. Chamber of Commerce. Action Course in Practical Politics. 1615 H Street, N.W., Washington, DC 20036 (202) 659-6000. $3.50.
Six pamphlets to train you in becoming active through your local political structure.

U.S. Congress, Office of Technology Assessment. The Effects of Nuclear War. Washington, D.C.: Government Printing Office, 1979.
The most comprehensive study of probable effects of nuclear war.

U.S. Department of Defense. Free Reports from the Department of Defense. The Washington Headquarters Service Directorate of Information, Room 4B, 938 Pentagon, Washington, DC 20301.
Write for a list of publications and an order form. Particular reports can be ordered by calling and asking for the papers by name.

Zuckerman, Solly. Nuclear Illusion and Reality. New York: Viking Press, 1982.
A succinct, eloquent, and brilliant editorial on the perils of nuclear politics; shows how to get out of the nuclear corner into which we have painted ourselves.

FILMS AND SLIDE SHOWS

The Day After Trinity: J. Robert Oppenheimer and the Atomic Bomb. (88 min., 16 mm.) Pyramid Films, P.O. Box 1048, Santa Monica, CA 90406. 1981.
Received an Academy Award nomination for best documentary. Shows how scientists like Oppenheimer collaborated to make the bomb, then became troubled and, in some cases, worked for disarmament. Highlights ethical issues.

Decision to Drop the Bomb. (35 min., b/w, NBC-TV) Available through University of California Extension Media Center #6900, $22 rental fee.
Factual, non-judgmental account.

The Defense of the U.S., '81. (CBS TV series, 52 minutes each.) $60 rental each, CBS, Delores Sura, 524 West 57th Street, New York, NY, 10019.
(1) Ground Zero
(2) The Nuclear Battlefield
(3) The War Machine
(4) The Russians
Best overall summary of U.S arms race and all it entails.

Fable Safe. (9 min., color, 1971). Museum of Modern Art, Film Program, 11 West 53rd Street, New York, NY 10019.
Animated film on folly of spiraling arms race.

John and Mary, MIRV and MARV: The Arms Race and the Human Race. (15 min., color slide show with tape narration) Institute for World Order, 777 UN Plaza, New York, NY 10017.
Urges the United States and the Soviet Union to realize no one can win the nuclear arms race. Leadership kit accompanies.

The Last Epidemic: Medical Conse uences of Nuclear War. (45 min., 16 mm. color or 3/4 video cassette) Impact Productions, 135 Hughes Ave., Santa Cruz,

or 3/4 video cassette) Impact Productions, 135 Hughes Ave., Santa Cruz, CA 95062.
Prominent scientists, doctors, and arms control specialists describe the medical results of an atomic attack. Action scenes are interspersed.

The Last Slide Show. (20 min. slide show with tape narration) Clergy and Laity Concerned, 198 Broadway, New York, NY 10038.
Hopeful and life-affirming presentation about the arms race. Ends on joyous note of people's ability to prevent nuclear war.

Missiles of October. (155 min., 16 mm. color) Learning Corporation of America, 1350 Avenue of the Americas, New York, NY 10019.
Dramatization of the Cuban missile crisis of October, 1962.

Nuclear Disaster. (slide show with cassette tape and transcript.) Center for Peace Studies, 2 O'Gara, Georgetown University, Washington, DC 20057.
Uses charts and Hiroshima photos to illustrate blast, firestorm, and radiation effects of nuclear weapons.

Nuclear War: What's in it for You? (slide show with cassette and transcript, $10). Ground Zero, 806 15th Street, N.W., #421, Washington, DC 20005.
General overview of nuclear war issues, excellent as discussion aid for people new to the subject.

One Thousand Cranes: The Children of Hiroshima. (24 min., b/w, 1968.) Audio Brandon Films, 34 Mac uestion Parkway, Mt. Vernon, NY 10550. (800) 431-1994.
Tests the ancient Japanese belief that folding 1000 paper cranes protects one from illness. Poignant testimony to the great psychological, as well as physical, effects of the Hiroshima bomb.

The Race Nobody Wins. (15 min. color slide show or filmstrip with guide and tape narration) SANE, 318 Massachusetts Avenue, NE, Washington, DC 20002.
Well-documented presentation of threat of nuclear war, costliness of international arms race. Narrated by Tony Randall.

Thinking Twice. (60 min., 1981). Public Interest Video Network, 1736 Columbia Road, NW, Washington, DC 20009.
Follows a typical American family through their changes of outlook when exposed to the nuclear war issue. Shows how people can work to prevent nuclear war.

The War Game. 47 min., 1968) Films Inc., 733 Green Bay Road, Wilmette, IL 60019. (312) 256-4730 for rental information; (800) 323-4222 for sales.
Powerful classic reenacting nuclear attack on Great Britain.

War Without Winners. (28 min., 1979) Center for Defense Information. Films Inc., address above.
Average Russian and American citizens expressing their fears and hopes for the future. A fresh and delightful appeal to reason.

GLOSSARY

ABM: Antiballistic Missile System: The interceptor missiles, radars, and assorted equipment of a system designed to intercept and destroy enemy ballistic missiles.

ABM TREATY: Signed at Moscow, 1972, ratified by the United States Senate with vote of 88-2; of limited duration. Limits both sides to minimal deployment of ABM launchers, interceptors, and radars at two locations; in 1974 this was reduced to one location each.

CIVIL DEFENSE: Protection of the general population, leadership, and industry from nuclear attack.

COUNTERFORCE CAPABILITY: Literally, the ability to destroy enemy military forces. However, the term is most often used to refer to the ability to destroy enemy ICBM silos.

CRUISE MISSILE: A pilotless jet plane, or, in technical terms, a guided missile that uses aerodynamic lift to counteract gravity and propulsion to counteract drag; frequently equipped with a guidance system that enables the missile to fly only a few hundred feet above the ground and thus avoid radar.

DELIVERY SYSTEMS: Any means (missile, bomber, etc., or a combination thereof) by which a weapon is delivered to a target.

DETERRENCE: A strategy or situation in which enemy leaders are convinced that aggression is an unattractive alternative because the potential losses(and risk of escalation) offset anticipated gains.

FALLOUT: Radioactive particles that are carried into the upper atmosphere by a nuclear explosion and fall to earth downwind from the explosion, often in rain.

FALLOUT SHELTER: A shelter covered by a material such as dirt or concrete which protects the occupants from the radioactivity in fallout. An effective fallout shelter requires some means of removing particles from the air taken into the shelter.

FIREBALL: The very hot (10,000,000 ^{o}F) central region of a nuclear explosion.

FIREBREAK: A cleared area cut in the path of a raging forest fire to contain it; by analogy, containment techniques such as arms control or improved international relationships which could prevent nuclear war.

FIRST STRIKE: Literally the first offensive move in war. The term is frequently used to refer to a major nuclear attack on enemy nuclear forces such as ICBM silos, bomber bases, etc. Also called <u>preemptive strike</u>.

FISSION: The splitting or breaking apart of a heavy atom into two new atoms. When a heavy atom, such as uranium, is split, large amounts of energy and two or three neutrons are usually released.

FLEXIBLE RESPONSE: A strategy for controlling escalation whereby an escalation by the enemy in the level of conflict is met with a measured response designed to limit the conflict to the degree possible.

FUSION: The fusing, or joining together, of two atomic nuclei in a reaction which releases large amounts of energy and one or more neutrons.

GAMMA RAYS: A form of high energy electromagnetic radiation emitted from a nucleus; require heavy shielding, such as lead brick, to stop them.

GROUND ZERO: The point at which a nuclear weapon is detonated. For an airburst, it is the point on the Earth's surface directly below the point of detonation.

HALF-LIFE: The length of time in which any radioactive substance will lose one-half of its radioactivity.

HARD TARGET: A target protected against the blast and associated effects of nuclear weapons through structural hardening.

INTERCONTINENTAL BALLISTIC MISSILE (ICBM): A ballistic missile capable of reaching targets at intercontinental distances, normally defined as a range in excess of 5,500 kilometers.

INTERMEDIATE-RANGE BALLISTIC MISSILE (IRBM): A ballistic missile with a range between 2,200 and 5,500 kilometers.

KILOTON: A thousand tons of TNT; a measure of the explosive power of nuclear weapons. One thousand kilotons equals one megaton.

LAUNCH ON WARNING: The policy or strategy of launching ICBM's on the basis of information supplied by satellite and other warning systems which indicates that an enemy missile attack is coming.

LAYDOWN: The process of matching nuclear weapons against targets on the other side.

LIMITED TEST BAN TREATY (LTBT): A Treaty signed in 1963 which prohibits the signatory nations from conducting nuclear weapons tests in the atmosphere, under water, or in space. Underground tests are permitted.

MEGATON: One thousand times a kiloton, i.e., the explosive force of one million tons of TNT.

MILITARY INDUSTRIAL COMPLEX: President Eisenhower's term to describe the combined interests of the military and the defense industry in obtaining new weapons systems.

MULTIPLE INDEPENDENTLY TARGETABLE RE-ENTRY VEHICLE (MIRV): Multiple re-entry vehicles carried by a ballistic missile, each of which can be directed to a separate and arbitrarily located target.

MUTUAL ASSURED DESTRUCTION (MAD): The strategy of preventing nuclear war whereby each side maintains an assured destruction capability.

NONPROLIFERATION TREATY (NPT): First signed in 1968, in which the signatory

nations that do not have nuclear weapons agreed to forego them while the signatory nations that do have nuclear weapons agree to work to prevent proliferation and assist in the development of peaceful uses of nuclear energy.

PRE-EMPTIVE STRIKE: See FIRST STRIKE.

PROLIFERATION: The process by which one nation after another comes into possession of nuclear weapons.

RADIATION: Energy in the form of gamma rays or particles which are emitted by disintegrating atoms.

RETALIATORY STRIKE: An attack on an enemy who has initiated hostilities with a first strike. Sometimes called a second strike.

SCENARIO: An imaginery chain of events described along with their possible repercussions and side effects -- often used in decision-making to evaluate possible courses of action.

SHORT-RANGE ATTACK MISSILE (SRAM): A missile with a range of about 100 kilometers and a warhead yield of 200 kilotons, carried on a U.S. bomber.

SILO LAUNCHER: A 'hard' fixed underground ballistic missile launcher, usually of steel and concrete, housing an intercontinental ballistic missile and the equipment for launching it.

SOFT TARGET: A target not protected against blast or the associated effects of nuclear weapons detonations.

SSBN: The U.S. Navy term for a nuclear powered ballistic missile submarine.

STRATEGIC ARMS LIMITATION TALKS (SALT): A series of negotiations between the United States and the Soviet Union which began in November, 1969. The negotiations seek to limit and reduce both offensive and defensive strategic arms. SALT I concluded in May, 1972, resulted in the ABM Treaty and an Interim Agreement on offensive arms. SALT II, signed in June, 1979, but not ratified by the U.S. Senate, is a comprehensive treaty limiting strategic offensive weapons.

STRATEGIC NUCLEAR WEAPONS: Generally refers to long-range nuclear weapons delivery vehicles, such as ICBM's, SLBM's, and intercontinental bombers.

SUBMARINE-LAUNCHED BALLISTIC MISSILE (SLBM): A ballistic missile carried in and launched from a submarine.

TACTICAL NUCLEAR WEAPONS: Generally refers to smaller nuclear weapons used on the battlefield or in other limited nuclear war situations.

THERMAL RADIATION: The 'heat' given off by a nuclear explosion.

THROW-WEIGHT: Ballistic missile throw weight is the useful weight that is placed on a trajectory toward the target by the boost stages of the missile.

TRIAD: The combination of ICBM's, SLBM's, and intercontinental bombers, each of which presents different defensive problems to the enemy.

VERIFICATION: The process of determining, to the extent necessary to adequately safeguard national security, that the other side is complying with an arms control agreement.

WARHEAD: That part of a missile or other munition which contains the nuclear or other explosive system.

YIELD: The energy released in a nuclear explosion, generally measured in kilotons (hundreds of tons) or megatons (millions of tons) of TNT required to produce the same energy release.